

Construction and Validation of Neurotransmitters Scale

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Abstract *In this research, we visit literature directed seven steps procedure of scale development and incorporate it in studying dopamine, serotonin, epinephrine and norepinephrine and thus finalized 16 items neurotransmitters scale. We incorporated 6 samples for construction of reliable multi-aspect questionnaire that imitated across the samples. We confirm the content adequacy qualitatively and quantitatively including discriminant and convergent validity. We also established the criterion-related validity through the instrument's relation with measures of behavioral aspects of individual investors. This research proposes that the neurotransmitters scale is valid and reliable. Neurotransmitters as dopamine, serotonin, epinephrine and norepinephrine have significant use for individual stock markets investors. This investigators hope that the corroborated scale is reliable as well as valid and will be appropriate to utilize in upcoming studies of neurofinance.*

Key Words:

Neurofinance,
Behavioral
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Neurotransmitters

Introduction

The world give attention in 2005 when the first study related to the neurotransmitters' role in financial decision making gives awareness to the individuals, who keenly occupied positions in the field of business, especially stock market business. The label of initial research was “neural basis of financial risk taking” by the (Kuhnen and Knutson, 2005) in the Stanford University. Due to the worth mentioning role of neural signal in stock market for investors show the need of advancement in the neurofinance.

The majority of the existing studies related to the neurotransmitter's aspects of investors appears in the developed world and proposed that connection stay alive among the dopamine, serotonin and buying as well selling of stocks.

The transformation in the financial system as well as scenery of equity investment sector from investing to profit/loss concentrated actions has activated the worth of neurofinance concept as neurotransmitters. The neurotransmitters are

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chemical messenger in human brain which generates the signals from one neuron to another neuron (Lodish et al., 2000). In individuals neurotransmitters enter into a most important responsibility in daily life and working (Cherry, 2015). Neurotransmitters composed of dopamine, serotonin, epinephrine and norepinephrine which may have association with behavioral aspects of individual investor. Healthy signal of human brain show the way to confirm and recognize the decision related to the investment of individuals. Harlow and Brown (1990) explored that, dopamine, serotonin and norepinephrine as the neurotransmitters, involve in signaling and have relation with investor's behavior. Neurotransmitters facilitate the superior plan of outlay of funds which may increase the efficiency of transactions and superior investment decisions.

Similarly, Frydman (2012) studied that dopamine, serotonin; epinephrine and norepinephrine function as neurotransmitters in the central neural scheme of human being. Other experts, Kuhnen and Knutson (2005) discussed the neurotransmitters as neural circuit. These neural circuits act as carrier of brain information. Neurotransmitters contribute toward the investors behavioral facets such as attitude of risk, optimism and confidence level.

Serotonin play major role in individual's behavioral decisions when based on hazard and worthwhile investment. Pompian (2006) explored that dopamine has contribution towards the investor's behavioral aspects for instance optimism, overconfidence and Loss aversion possibly will be a straight forward outcome of low level of serotonin. Individuals have different attitude towards the risk as Preuschoff et al (2006) illustrated that dopamine is associated with risk and reward. Specialist, Kuhnen and Chiao (2009) studied and found that neurotransmitters, dopamine and serotonin, are important factors of risk taking, decisions of investment. The above mentioned neurotransmitters have consequence towards the method a human being process the facts and figures related to the financial incentive as well as the loss avoidance.

Roe et al (2009) studied that neurotransmitter as dopamine and serotonin are considered to be connected with risk attitude. Pompian (2006) explored that the most of individual investors earn profit in the stock market during the panic situations as well as during the fight or flight situations. Similarly, Cohen and Hamrick (2003) explored that the neurotransmitters, norepinephrine and epinephrine, give force to run away or probably keep him in a struggle. Kuhnen et al (2013) studied that in individuals; presence of less serotonin indicates that less involvement in the equity investment and fewer lines of credit.

Purpose of neurofinance facets; neurotransmitter is to achieve antagonistic, neurotic and practicable gain within an emerging and information base liberated financial system of economy. This competitive advantage may be expected if the neurotransmitters boost up the worth of security traded in stock market. Krugel et al. (2009) disclosed the consequence of dopamine for behavior like thrill-seeking. Anderson, A., et al. (2015) studied 149 active investors in Sweden and explored

that neurotransmitter namely dopamine and serotonin have relation with behavioral aspect of investment as loss aversion as well as financial risk taking.

The capability of investors to carry on and nurture in the 21st century, awareness base market can be controlled, depending upon know-how of effective and efficient neurotransmitters to exploit financial assets of investors. As we know that the neurotransmitters in the nervous system push and slow up different activities like temperament adjustment and fly away or fight situations in the stock market. The signals improve the behavioral aspects of investor which may utilize for highest worth oriented performance in the stock market. Similarly, Harden and Klump (2015) disclosed that neurotransmitter's signals movement in human brain act as hammering force for the behavioral aspects.

Shao, Zhang, & Lee (2015) documented that role of neural bases in individual investors when they make decisions regarding the total sum of appreciated outlay of funds and percentage of required return.

Investigation related to the neurotransmitters measure is significant in support of attaining the valuable investment. Efficient as well as effective neurotransmitters for the reason of each component, seeing that are insubstantial form as well as difficult to identify, seeing as instruments for the quantifying the measures of neurotransmitters are at emerging arena. Many investigations in the different region of the world prove the significance of neurotransmitters measures as Mosher and Rudebeck (2015) recognized that neurotransmitter scheme corridor passes the signals related to the investment plane with high value depending upon the investment horizon.

The main basic measure of neurotransmitter is dopamine which has effect on the behavioral aspect of investor. Mohr and Heekeren (2012) confirmed that dopamine have prominent function in risky behavior while making investment. Appropriate neurotransmitters believe squabble that some variation in dopamine and serotonin may get better investor behavior as well as benefits in stock market.

When individual make investment in the stock market different psychological situations arises in the mind then neurotransmitters play prominent role of adjustment in the memory due to which investor feel comforts. Dornelles, et al. (2007) studied and found that neurotransmitter namely epinephrine makes adjustment in the human remembrance process for the psychologically triggering situation.

In view of the exceeding point of view, neurotransmitters would be considered the same as a force for recital for individuals who make investment. Administrator of investment firms, executives of wealth Management Company and supervisor of funds value the significance of effective and efficient human neurotransmitters measures in the accomplishment of open and emerging market economy.

The Scale Development Process

Researchers in neurofinance use specific psychometric instruments in field other than the laboratory (Peterson, 2014). In field study, most of time commonly used technique for data gathering is questionnaire (Stone, 1978). Unluckily, questionnaires repeatedly have faced the reliability and validity issue which may leads to complexities in interpretations of outcomes of research (Schriesheim, et al., 1993). Valid scale development is a tricky as well as lengthy procedure (Schmitt & Klimoski, 1991). The main purpose of development of questionnaire is to build up appropriate estimate of substance of measure (Clark & Watson, 1995). Schoenfeldt (1984) mentioned that instruments development may be the most significant section of every research.

In the past, various parameters have been considered for evaluating the credibility of instrument. As the American Psychological Association (1995) described that instrument must have the internal consistency, content and construct validity including criterion-related validity. Till now, as best of my knowledge, in neurofinance research measures of neurotransmitters, specially dopamine, serotonin, epinephrine, Norepinephrine, have not been fully developed or inadequate or unsuitable or unavailable scale because of lack of interest of neurofinance researchers. A deep-rooted structure to lead the academic investigators with the help of different steps of scale construction in the field of neurofinance is required. To evade various procedural issues of prior work we have to prefer to develop the questionnaire undoubtedly (Aupperle, Carroll and Hatfield, 1985).

This valid and reliable scale construction is based on procedure provided by the Churchill (1979); Hinkin (1995); Hinkin, Tracey and Enz (1997); Hinkin (1998). Hinkin, Tracey and Enz (1997); Kinicki et al. (2013) and Zheng, et al. (2015). Hinkin (1998) discussed the process having different steps for development of questionnaire and analysis, to demonstrate the most suitable techniques to sketch the valid and reliable instrument. In the following pages different phases of development of scale will be discussed in detail.

Phase 1: Item Generation

The process of development of scale starts through the items generation to evaluate an idea under assessment (Hinkin, Tracey and Enz, 1997). We should produce the items by use of inductive and deductive method of research according to the recommendation of (Hinkin, 1998). According to the Kinicki et al. (2013) deductive method will helpful for the start of procedure as previous measure may be supportive for the construct development and inductive method will be required for additional help of deductive view point of measure because of broad and invalid measure in past. Schwab (1980) said that existence of some theories about the

construct may guide for the generation of items while performing the process of scale development.

There is no precise policy regarding the exact number of items for scale however very few useful method be present. Thurstone (1947) explored that a construct may be internally reliable as well as closed-fisted, consist of the least numeral of statements that sufficiently evaluate the area of curiosity. Harvey, Billings and Nilan (1985) in their study found that satisfactory internal uniformity and trustworthiness of scale could be attained with the help of four or five statements for each construct. Schmitt and Stults (1985) investigated and revealed that construct with minimum items is a successful way of reducing the biasness in responses of individuals reasoned by tediousness or tiredness. As per the Ghiselli, Campbell & Zedeck (1981) theory of domain sampling tells that, it is essential that the sample of statements or items used from inventory of prospective items sufficiently symbolizes the measure under assessment. For example, Song et al. (2010); Ge and Lui (2015) in their research used questionnaire with 111 items to measure the few facets of neurotransmitters.

However, on the base of given literature, it is decided to choose, 94 items for four constructs of neurotransmitters as dopamine, serotonin, Norepinephrine and Epinephrine, from two American practitioners Colbert (2013) and Tessler (1997) because of existence of theory about the phenomenon is being study. These items have never been used by academicians for research and never gone through scale development process. For more confirmation about the 94 behavioral items of neurotransmitters, further these discussed, with one expert of content domain, about the unnecessary items, defectively worded, or not required to the domain of content. According to the Kinicki et al. (2013), this process is said to be the preliminary evaluation.

Once the items or statements in the questionnaire have been finalized then as per the procedure of development of questionnaire, it is moment of carry out a first round of test for the adequacy of contents of the statements of measures.

Phase 2: Content Adequacy Assessment

Mostly researchers spent energy and time for data collection in damaged construct without confirming the adequacy of contents of items. In this study, items pretesting process will be helpful exercise for the validation of scale before ultimate survey instrument. Literature of research revealed the number of ways for the assessment of content adequacy (Nunnally, 1978). As Hinkin (1998) said that most frequently used technique is to classify or sort statement or substance or items on the base of similarity to definition of measures with the help of experts in content domain or respondents who can read and understand the statements or students of contents domain.

According to Nunally (1978) the assessment of contents adequacy could be carry out through the panel of jury having understanding about the contents area.

Step 1: The preliminarily judge analysis performed to evaluate the content adequacy of early 94 items. For this, questionnaire circulated among the group of 60 individuals, from which 18 were university faculty members with average age of 38 year, 25 were M.Phil level students and 17 were graduate level students. The average age of student was 25 year and 30 percent of the respondents were female. Questionnaires were circulated among the faculty members during the office timing and among the students in class time and detail discussion made and information given about the questionnaire and dimension of measures and then asked to complete the survey.

The request made to the respondent that they agree or not with the given statements and their relative dimension. Moreover it was confirmed the truthful fraction of agreement for each item and apply the 80 percent standard for harmony to hold items for further investigation. According to the Kinicki et al. (2013), while deveoloping the scale used standard of 80% for agreement for each item. All the judges made consensus about the 86 items.

Step 2: A second judge analysis of the items performed with the help of 30 respondents including one practitioner cum faculty member two university faculty members and 27 M.Phil. level students including 20% female. Author met to the respondent in their offices and classes, made detail discussion and provide detail information about the statements and related dimensions then asked to complete the survey. The standard of 80% agreement was used and all the respondents in second judge analysis agreed about all of the items holding for further analysis. As said by Nunnally (1978), this procedure indicates one way for investigating the content validity.

According to Hinkin et al. (1997) and Hinkin (1998), no one of the mentioned method will assure the contents validity; however these techniques give indication of reasonable items for the measurement of the variable as well as minimize the requirement of amendment of succeeding instrument. Right now in the procedure, the investigator holds the statements for process that previously vigilantly developed as well as evaluated with the help of specialist.

Phase 3: Questionnaire Administration

In this phase, the investigator will utilize the 86 statements or items that have been survived in the content validity assessment process discussed above for measurement of construct and how deeply these statements or items will prove the hope of psychometric features like discriminant, convergent and criterion-related validity, as discuss in subsequent parts.

Items Scaling: Previously retained items are taken on five point Likert scale and asked to the respondent to allocate up to the five points because of minimization of desirability of respondents. Aupperle et al. (1985) recommended the methodology of force choice in questionnaire base study to limit the wishes of persons providing information. As suggested by Lissitz and Green (1975), five points Likert scale used to produce variance in order to examine the associations between statements, scales as well as to produce satisfactory level of internal consistency and coefficients of reliability. The huge and main stream of scholar while developing the questionnaires used the Likert scale for measurement (Schmitt & Klimoski, 1991).

Sample Size: There has been extensive discussion regarding the size of sample for suitable assessment of statistical importance. During this phase of construction of instrument, the investigator confirmed the gathering of data through appropriate size of sample to perform the subsequent statistical tests. It has been shown; the specific number of items or variables selected for assessment will indicate about the size of sample. For factor analysis, suggested sample size depend upon the ratio of item and response that may vary from 1 to 4 and 1 to 10 (Rummel, 1970; Schwab, 1980).

In the pretest stage of content validity procedure, as suggested by the Schriesheim et al. (1993); Anderson and Gerbing (1991) sample of 65 will be suitable and then 2 sample of twenty for later use may be appropriate. According to the Guadagnoli and Velicer (1988), to obtain the precise result in exploratory factor analysis 150 respondents will be appropriate. Hoelter (1983) recommended that, at least 200 observation for confirmatory factor analysis but later Bollen (1989) investigated and recommended that at least 100 observations will be appropriate for confirmatory factor analysis.

However, researcher used a traditional way regarding the size of sample in the study and decides to use 200 observations for further analysis. After completing the task of data collection, it is necessary to assess the validity of instrument with the help of factor analysis

Phase 4: Factor Analysis

Psychometric features of scale are assessed with the help of consistency and trustworthiness as well as construction of factors. As suggested by Schriesheim et al. (1993) assessment of adequacy of contents of items quantitatively can be done with the help of factor analytical techniques because of limitation of judgmental injustice of human. Researcher performed the construction of factors with the help of two stage procedure. In first stage, as Ford et al. (1986) said, judge analysis on the base of two grounds, economical and convenient length of scale. In second

stage, According to the Gerbing and Hamilton (1996), scale developers perform exploratory factor analysis before the confirmatory factor analysis. As we know that EFA is used for reduction of items as well as CFA is used to check the worth of instrument. As Fabrigar et al. (1999) said, exploratory factor analysis is applied by the investigators while constructing an instrument and provides identification of unobserved variables.

According to the Yong and Pearce (2013), exploratory factor analysis is applied to recognize unobserved variables or dynamics and is generally employed to shrink the constructs to a lesser part due to the two reasons, one is time saving and other is easy explanation. This is also said by the Williams et al. (2010) as exploratory factor analysis is a main procedure, which is used in construction, fine-tuning and assessment of questionnaire. Harrington (2009) disclosed that scale developer employ the confirmatory factor analysis for the purpose of psychometric assessment and validity of measures.

Exploratory Factor Analysis: Researcher collected the data with help of questionnaire having 86 items previously confirmed in the two steps judge analysis, from 250 university students having knowledge of content domain then found 51 questionnaires incomplete and 199 questionnaires appropriate for further analysis. Researcher do not asked to respondents to provide the demographics to maintain the secrecy of respondents as Roch and McNall (2007) suggested that lack of profile of respondents improve correctness of outcome.

Before exploratory factor analysis author performed the items analysis with the help of inter items correlation matrix and found more than 0.20 value of coefficients of 67 items out of 86 and remaining deleted and later on these 67 items confirmed in EFA because Churchill (1979) disclosed that lower value of correlation coefficient shows that items not belong to suitable domain due to which chances of inaccuracy and unreliability increases. The reliability statistics through Cronbach's Alpha 0.91 for 86 items calculated.

As Kim and Mueller, (1978) recommended, before factor analysis inter items correlation should be performed to check that either or not items fit in to content domain. As, Piedmont (2014) mentioned that inter-item correlation is an important ingredient, in carry out an analysis of items in scale development, having value more than 0.20 for each item which indicate that items are representative of content domain. According to Cronbach (1951), scale reliability or internal consistency problem can be clarify through the inter-item correlations because it tell us how better scale is quantifying the construct. After deleting of items having less than 0.20 values of correlation coefficient then Cronbach's alpha improve from 0.91 to 0.93. Then reliability statistics through Cronbach's alpha for each construct as 0.798, 0.908, 0.943 and 0.947 respectively for Dopamine, Serotonin, Epiphrine and Norepiphrine.

Exploratory factor analysis performed by using the five steps guidelines of (Williams et al., 2010). First, with the help of Kaiser-Meyer-Olkin Measure of Sampling Adequacy 0.787 confirmed that data is suitable for exploratory factor analysis, as the Kaiser (1974) recommended that range of value should be as 0.00 to 0.49 unacceptable, 0.50 to 0.59 wretched, 0.60 to 0.69 just adequate, 0.70 to 0.79 adequate, 0.80 to 0.89 admirable and 0.90 to 1.00 excellent and Comrey and Lee (2009) indicated that 200 sample size as reasonable. Second, factors extracted with the help of the Principal Component Analysis method and third, orthogonal varimax rotation to wish for four factor solution by researcher because Pett et al. (2003) also recommended the PCA and Osborne and Costello (2005) suggested the orthogonal varimax method for rotation when factors are uncorrelated and also said that no single criteria for extraction of factors.

Subsequently, four factors are confirmed with 43.4% value of Cumulative Percentage of Variance and Eigen value more than 1. Finally, author retained 67 items by employing value 0.30 as lowest point for each statement or item for factor loading and 19 items deleted because of lack of support. As Kinicki et al. (2013) said minimum 0.30 weight is appropriate for items loading. Similarly, the robust of results of inter item correlation matrix checked through the EFA. These 67 items retained for confirmatory factor analysis to check the significance of scale.

Confirmatory Factor Analysis: One of the primary limitations of exploratory factor analysis is the failure to compute the goodness of fit of the resultant factors (Long, 1983). The indicators that fulfill the criteria of an exploratory factor analysis may not have fit in measurement model because of not having external consistency (Gerbing and Anderson, 1988). Most of time CFA is used for validation of constructs (Levine, 2016). Confirmatory factor analysis is just affirmation about the previous examination because as MacKenzie, Podsakoff, and Fetter (1991) suggested that, at this time approximately 30 goodness-of-fit indices used to evaluate confirmatory factor analysis outcome.

Author performed the CFA with the help AMOS.20 and 67 items stay alive in EFA and got four possible models with four possible factors (dopamine, serotonin, Epiphrine and Norepiphrine) solution. In CFA 16 items retained by correlating the different items and remaining 51 deleted and model fitness criteria assessed with the help of absolute measure fit (GFI, RMR, RMSEA and CMIN/DF) and incremental measure fit (TLI, CFI, NFI, AGFI and IFI) and parsimony adjusted measure (PGFI and PNFI) see Table.1.

Medsker, Williams, and Holahan (1994) advised that the chi-square statistic, Comparative Fit Index (CFI) and the Relative Non-centrality Index (RNI) can be suitable to verify the superiority of fit with different situation in the data. Generally fitness of model was assessed with the help of two indices of fit as the comparative fit index (CFI; Bentler, 1990) and the non-normed fit index (NNFI; Bentler & Bonnett, 1980). Along with these indices of fit, the root mean square error of

approximation (RMSEA) evaluated the fitness of model, if the value of RMSEA is 0.05 or smaller show strong fit, among .05 and .08 show logical fit, as well as figures between .08 and .10 show ordinary fit (Browne & Cudeck, 1992).

Table1. Summary of Model Fit Indices

Types of Measure Fit	Mode 11	Mode 12	Mode 13	Model 4	Mode 15	Level of Acceptable Fit
Absolute measure fit						
GFI	0.931	0.932	0.932	0.927	0.919	≥0.90
RMSEA	0.030	0.039	0.037			<0.050
χ ² /df (CMIN/DF)	1.183	1.296	1.276	1.355	1.476	<5
RMR	0.076	0.09	0.087	0.89	0.92	<0.90
Incremental fit measures:						
TLI	0.983	0.969	0.971	0.963	0.950	≥0.95
AGFI	0.902	0.901	0.904	0.897	0.887	≥0.80
CFI	0.987	0.976	0.977	0.970	0.959	≥.95
IFI	0.987	0.976	0.977	0.971	0.960	≥0.95
NFI	0.920	0.904	0.903	0.896	0.886	≥0.90
Parsimonious fit measures:						
PGFI	0.653	0.644	0.658	0.661	0.662	0-1
PNFI	0.722	0.708	0.723	0.725	0.724	0-1

Hu and Bentler (1999) recommended in support of model fit as RMR values close to .09, RMSEA values close to .06 or below, CFI and TLI values close to .95 or greater and along with GFI ≥ 0.90. The cutoff values for χ²/df (CMIN/DF) is recommended 1 as lower limit and 2 to 3 or 5 as upper limit, AGFI ≥ 0.80, IFI ≥ 0.90, NFI ≥ 0.90, PGFI and PNFI values 0 to 1. (Gulla & Purohit, 2013). Commonly a CMIN/DF statistic lower than 5 is believed satisfactory, as lesser values consider better (Thomson et al., 2005).

Additionally, five models observed the loading as of 18 items on appropriate 4 factors in model-1, as 4 items loaded on dopamine, 4 items loaded on serotonin, 6 items loaded on Norepinephrine 4 items loaded on Epinephrine and detail can be seen in table-2. Furthermore model-2 to 5 showed the loading of 16 items on appropriate

4 factors as 4 items loaded on dopamine, 4 items loaded on serotonin, 4 items loaded on Norepiphrine 4 items loaded on Epiphine and detail can also be seen in table-2

Table 2: 18 Items Loaded on 4 Constructs (Model-1) and 16 Items Loaded on 4 Constructs (Model: 2 to 5)

Factors	Items	Loading 1	Items	Loading 2	Loading 3	Loading 4	Loading 5
Serotonin	S5	0.618	S7	0.702	0.851	0.85	0.445
	S6	0.606	S8	0.662	0.796	0.797	0.555
	S10	0.666	S10	0.654	0.526	0.527	0.797
	S14	0.551	S11	0.521	0.408	0.408	0.834
Dopamine	D20	0.569	D20	0.574	0.574	0.574	0.574
	D19	0.667	D18	0.834	0.831	0.831	0.831
	D17	0.555	D16	0.558	0.559	0.56	0.56
	D15	0.578	D15	0.654	0.658	0.658	0.658
Epinephrine	E8	0.801	E8	0.707	0.629	0.629	0.629
	E7	0.773	E6	0.769	0.799	0.798	0.798
	E6	0.693	E4	0.885	0.839	0.84	0.84
	E5	0.746	E1	0.57	0.604	0.604	0.604
Norepibephrine	N8	0.794	N6	0.772	0.797	0.813	0.705
	N9	0.881	N7	0.726	0.847	0.814	0.836
	N10	0.817	N8	0.847	0.819	0.836	0.814
	N11	0.806	N12	0.743	0.75	0.705	0.813
	N12	0.805					
	N14	0.764					

Till now all these five models fulfill the criteria of goodness of fit and show appropriate loading of items on appropriate expected factors but which one model is best suitable will be decided later on after completion of further analysis.

Phase 5: Internal Consistency Assessment

Internal consistency is a gauge of reliability and indicates the intensity of items in the construct about the different facet of the similar trait (Revicki, 2014). Internal consistency assesses the steadiness contained by the scale as well as items how fine a depository of statements quantifies a specific attribute (Drost, 2011). Reliability is said to be the degree where a construct cedes the equal value all time when it is governed, all else unchanged (Hays and Revicki, 2005). Most common satisfactory gauge in survey investigation for evaluating internal consistency of

scale is Cronbach's alpha with the help of which it is notify that how good the statements assess the similar measure (Price & Mueller, 1986).

Cronbach alpha is the coefficient 0 to 1 commonly used to estimate the reliability of instruments based on internal consistency. As Hinkin (1997) said, internal consistency should be assessed after EFA and CFA. After exploratory and confirmatory factor analysis, it was determined internal consistency with help of Cronbach's alpha twice: first, scale with 18 items having Cronbach alpha 0.833 for 4 constructs as values of alpha 0.7, 0.73, 0.92 and 0.88 respectively for dopamine with 4 items, serotonin with 4 items, Norepinephrine with 6 items and Epinephrine with 4 items. Second, scale with 16 items having Cronbach's alpha 0.796 for 4 constructs as values of Cronbach's alpha 0.75, 0.76, 0.87 and 0.80 respectively for dopamine with 4 items, serotonin with 4 items, Norepinephrine with 4 items and Epinephrine with 4 items.

Obviously, the value of coefficient alpha is one of the very significant as well as persistent statistics in investigation concerning scale development (Cronbach's, 1951). According to the Cortina (1993), an instrument having more than 14 statements or items with alpha value 0.7 is satisfactory for freshly constructed scale. Next step is to confirm the validation of scale.

Phase 6: Construct Validation

In the previous phases, content validity and internal consistency of the newly constructed instrument has been confirmed, these two shows the proof of validity of construct. Moreover proof of validity of construct can be provided with the help of convergent, discriminant and criterion-related validity.

Convergent Validity: Confirmatory factor analysis applied to evaluate validity of construct (Joreskog, 1969). But according to Campbell and Fiske (1959), construct validity assessment has two sides, one is said to be the convergent validity as self-assurance level about the feature which tell us how good construct is assessed by the mentioned observed variables and second, discriminant validity as the extent to which variables of diverse characteristics are dissimilar. Fornell and Larcker (1981) standard usually applied to evaluate the extent of communal variance among the underlying constructs.

In accordance with standard, the convergent validity evaluate with the help of Average Variance Extracted (AVE) and Composite Reliability (CR), whereas the value of AVE 0.5 and value of CR 0.7 are acceptable. But according to Hair *et al.*, (2006) Composite Reliability (CR) value between 0.6 and 0.7 is acceptable. Similarly, Kotcharin *et al.* (2012); Gulla and Purohit (2013) suggested that AVE value 0.48 is also acceptable.

On the base of methodological recommendation of literature related to convergent validity for five appropriate models of CFA, author calculated the

values of average variance extracted (AVE), composite reliability (CR) for dopamine, serotonin, epinephrine and Norepinephrine. The values of AVE and CR of five different models can be seen in table-3

Table 3. Convergent Validity of Constructs

(A)				
Model-1	Measures	Items	AVE	CR
	Dopamine	4	0.4	0.6
	Serotonin	4	0.4	0.6
	Epinephrine	4	0.6	0.6
	Norepinephrine	4	0.7	0.9

(B)				
Model-2	Measures	Items	AVE	CR
	Dopamine	4	0.4	0.6
	Serotonin	4	0.4	0.6
	Epinephrine	4	0.5	0.7
	Norepinephrine	4	0.6	0.8

(C)				
Model-3	Measures	Items	AVE	CR
	Dopamine	4	0.5	0.6
	Serotonin	4	0.5	0.6
	Epinephrine	4	0.5	0.7
	Norepinephrine	4	0.6	0.8

(D)				
Model-4	Measures	Items	AVE	CR
	Dopamine	4	0.4	0.6
	Serotonin	4	0.5	0.6
	Epinephrine	4	0.5	0.7
	Norepinephrine	4	0.6	0.8

(E)				
Model-5	Measures	Items	AVE	CR
	Dopamine	4	0.5	0.6
	Serotonin	4	0.5	0.7
	Epinephrine	4	0.6	0.8
	Norepinephrine	4	0.5	0.7

Table-3 results indicate that model three and five show better and acceptable values of average variance extracted and composite reliability which indicates that observed variables converge to the latent variables appropriately.

Discriminant Validity: Evaluation of discriminant validity becomes precondition for exploring associations among hidden constructs (Henseler et al.2015). According to Fornell and Larcker (1981), discriminant validity assessment can be achieved by comparing the AVE of latent variable and maximum share variance or squared correlation of constructs. As said by this standard, for each construct the values of AVE must be greater than maximum share variance or squared correlation of other constructs.

For this we use the above mentioned five models from confirmatory factor analysis and determined the square of correlation or maximum shared variance (MSV) of latent variables in each model. For assessment of discriminant validity, we compared the values of square of correlation and AVE. Then it is checked that values of AVE are greater than the values of square of correlation of each construct which indicates that dopamine, serotonin, Epinephrine and Norepinephrine discriminate with each other appropriately.

The values of square of correlation of dopamine, serotonin, Epinephrine and Norepinephrine in five different models can be seen in table-4. From the results of table-4 can be seen that values of AVE are greater than the values of MSV for dopamine, serotonin, Epinephrine and Norepinephrine in all five different models.

Table 4. Discriminant Validity of Constructs

Correlation ² or Maximum Share Variance (MSV)							
			Model-1	Model-2	Model-3	Model-4	Model-5
Dopamine	<-->	Serotonin	0.001296	0.003364	0.001024	0.001024	0.001369
Dopamine	<-->	Epinephrine	0.002401	0.000009	0.000400	0.000400	0.001600
Dopamine	<-->	Nor-epinephrine	0.006084	0.001156	0.000900	0.001600	0.000400
Serotonin	<-->	Epinephrine	0.355216	0.272484	0.207936	0.207936	0.229441
Serotonin	<-->	Nor-epinephrine	0.253009	0.251001	0.226576	0.231361	0.212521
Epinephrine	<-->	Nor-epinephrine	0.180625	0.193600	0.212521	0.207025	0.207025

Till now, the results mentioned in the above tables, indicates that values of average variance extracted, composite reliability and maximum share variance are appropriate and acceptable for convergent and discriminant validity.

Criterion-Related Validity: For the assessment of criterion-related validity, investigator must observe the associations among the fresh construct as well as theorized measure to build up the idea of attention in the research (Cronbach & Meehl, 1955). According to Hinkin (1998), associations among the new measure as well as theorized variables must be supported with the help of theory as well as by observing the correlation analysis and this association must be statistically significant for the confirmation of criterion-related validity. For this, author accumulated the data of five related resulting measures of dopamine, serotonin, epinephrine and Norepinephrine.

As per opinion of Pompian (2006) some behavioral aspects of investors are results of neurotransmitters as dopamine, serotonin and epinephrine. These five resulting variables as investment horizon, risk attitude, Personalization of Loss, confidence and control are evaluated by using the 21 items scale on 5 point Likert scale (Wood & Zaichkowsky, 2004). The result of correlation analysis between neurotransmitters and behavioral outcome of investor reveals that some of variables are significant at the 0.01 level and some are significant at 0.05 levels. The final phase in development of questionnaire procedure is replication. The concluding items of questionnaire can seen in the Appendix

Phase 7: Replication

In replication phase, it is possibly squabbled that, due to the false variance caused by the measurement technique (Podsakoff, MacKenzie, & Podsakoff, 2003) and prospective complexities due to the common variance method, it is unsuitable to employ the identical set of data for scale construction as well as for the assessment of psychometric features of a newly developed construct (Campbell, 1976). The use of independent data set will generalize the newly constructed variable (Stone, 1978). For this, Anderson & Gerbing (1991) suggested the administration of one more self-sufficient set of data.

For these reasons, researcher collected another independent set of data of 199 sample size from the individuals who have suitable knowledge of content domain. Newly administered scale have 16 items of neurotransmitters as dopamine, serotonin, Epinephrine and Norepinephrine, survived in previous phases of scale development process. Then performed the confirmatory factor analysis, assessment of internal consistency reliability, and convergent, discriminant, and criterion- related validity for evaluation of psychometric features of scale.

Confirmatory factor analysis of previously survived 16 items of dopamine, serotonin, epinephrine and Norepinephrine shows the appropriate loading as seen

in table-1, RMR values is .09, RMSEA values is .04, CFI, TLI, IFI, NFI, PNFI and PIFI values are 0.98, 0.97, 0.98, 0.91, 0.72 and 0.77 along with GFI, AGFI and PGFI value 0.93, 0.90 and 0.65. The value for χ^2/df (CMIN/DF) is 1.30. These results of CFA indicates that model is fit as per the standard describes in literature.

Table 5: 16 Items Loaded on 4 Constructs, Internal Consistency Reliability and Convergent Validity

Factors	Items	Loading	Cronbach's alpha	AVE	CR
Serotonin	S7	0.51	0.823	0.515	0.709
	S8	0.64			
	S10	0.78			
	S11	0.88			
Dopamine	D20	0.58	0.814	0.511	0.703
	D18	0.58			
	D16	0.83			
	D15	0.82			
Epiphrine	E8	.80	0.737	0.50	0.66
	E6	0.77			
	E4	0.72			
	E1	0.40			
Norepiphrine	N6	0.71	0.784	0.51	0.708
	N7	0.84			
	N8	0.63			
	N12	0.66			

Table 5 indicates that values are acceptable.

Table 6. Discriminant Validity of Constructs

			MSV
Dopamine	<-->	Serotonin	0.082
Dopamine	<-->	Norepinephrine	0.082
Dopamine	<-->	Epinephrine	0.074
Serotonin	<-->	Norepinephrine	0.042
Serotonin	<-->	Epinephrine	0.053
Norepinephrine	<-->	Epinephrine	0.046

Table 7. Criterion-Related Validity

Correlation coefficient indicates that an association among the new measure as well as theorized variables is supported and this association is statistically significant for the confirmation of criterion-related validity.

Correlations									
	IH	RA	PL	Confi	Control	D	S	N	E
IH	1								
RA	.354**	1							
PL	.298**	.518**	1						
Confi	.542**	.600**	.449**	1					
Control	.382**	.622**	.724**	.480**	1				
D	.208**	.210**	.071	.172*	.180*	1			
S	.647**	.462**	.385**	.645**	.455**	.169*	1		
N	.499**	.690**	.495**	.611**	.631**	.188**	.511**	1	
E	.446**	.458**	.392**	.525**	.466**	.199**	.554**	.550**	1
**. Correlation is significant at the 0.01 level (2-tailed).									
*. Correlation is significant at the 0.05 level (2-tailed).									

- IH = Investment Horizon
- RA = Risk Attitude
- PL = Personalization of Loss
- Confi = Confidence
- Control = Control
- D = Dopamine
- S = Serotonin
- E = Epinephrine
- N = Norepinephrine

Conclusion

Superior investigation initiates with superior scale. Due to this; we have visited the literature directed seven steps procedure for construction of scale of neurotransmitters and finalized that dopamine, serotonin, epinephrine and norepinephrine with 16 items. This study was with anticipation that neurofinance investigators will use this logical advancement to measure the level of dopamine, serotonin, epinephrine and norepinephrine of stock market investor. Above mentioned process of questionnaire development found that constructs which come out will be glowing psychometrically (Mackenzie et al., 1991). This investigation will give the hope that the corroborated scale is reliable as well as valid and will be appropriate to utilize in upcoming studies of neurofinance.

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Appendix:

**Neurotransmitters (Dopamine, Serotonin, Epinephrine and Norepinephrine)
Questionnaire**

Dopamine

1. I have episodes of low blood sugar with light-headedness, irritability, extreme hunger, and cloudy thinking.
2. I get excessive amounts of sleep and still awaken tired.
3. I am easily angered, irritated, or frustrated.
4. I need medication to cope with or forget my problems.

Serotonin

1. I eat when I am not hungry.
2. I eat massive quantities of food at one time.
3. I eat unconsciously and wonder why after that.
4. I eat such large quantities of food that I get nauseated.

Epinephrine

1. I feel difficulties or problems with stress, mental clarity, maintaining my focus, organizing my thoughts, making decisions, and feeling out of control.
2. I find it difficult to concentrate on my job or projects.
3. I feel eye fatigue that affects my job, work or reading enjoyment.
4. I feel difficulty while starting work/job/projects.

Norepinephrine

1. I feel out of control, especially with my hunger.
2. I think about food most of the time.
3. I have strong desire of breads or pastas rather than sweets or junk food.
4. I feel down, depressed, or unexciting.